

What is claimed is:

1. A microstructure relay comprising:

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5 a body including upper and lower portions, wherein the lower portion is formed from a substrate and the upper portion is formed on the substrate to avoid bonding of the lower portion to the upper portion;

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10 a support member having a first end fixed to the body to form a cantilever, wherein an upper surface of the support member and a lower surface of the upper portion of the body forms a cavity; and

a first contact region located on the upper surface at a second end of the support member, the first contact region comprising a first contact, wherein pivoting the support member toward the lower surface causes the first contact to be electrically coupled to a counter contact.

2. The microstructure relay of claim 1 wherein the support member is pivoted toward the lower surface by electrostatic force, the electrostatic force generated by applying a voltage potential to the first and second electrodes, the first electrode is located on the upper surface and the second electrode is located on the lower surface.

3. The microstructure relay of claim 2 further comprises a second contact region on the lower surface, the second contact region comprising the second contact.

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4. The microstructure relay of claim 3 wherein the support member comprises an s-shape to provide for over-travel when the support member is pivoted toward the lower surface.

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5. The micro-structure relay of claim 4 wherein the s-shape support member comprises first and second stress layers, the first stress layer inducing a compressive stress on the support member to cause it to bend away from the lower surface, and the second stress layer inducing a tensile stress on the first contact region to cause the first contact region to bend toward the lower surface.

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6. The microstructure relay of claim 5 wherein the bend of the first contact region toward the lower surface defines an over-travel.

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7. The microstructure relay of claim 6 further comprising an over-travel region in the lower surface, the over-travel

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region accommodating the bend of the first contact region to prevent the over-travel from being obstructed.

8. The microstructure relay of claim 7 wherein the support member comprises silicon.

9. The microstructure relay of claim 8 wherein the first stress layer comprises silicon oxide.

10. The microstructure relay of claim 9 wherein the second stress layer comprises silicon nitride.

11. The microstructure relay of claim 10 wherein the lower portion of the body comprises silicon.

12. The microstructure relay of claim 11 wherein the upper portion comprises nickel.

13. The micro-structure relay of claim 12 further comprising a dielectric layer insulating the upper portion of the body from the second contact and second electrode.

14. The microstructure relay of claim 7 wherein the support member comprises nickel.

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15. The microstructure relay of claim 14 wherein the first stress-inducing layer comprises silicon oxide and the second stress-inducing layer comprises polysilicon.

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16. The microstructure relay of claim 15 wherein the polysilicon comprises doped polysilicon.

17. The micro-structure relay of claim 16 further  
10 comprises a compensation layer on a surface of the support member opposite the upper surface, the compensation layer having a thermal coefficient of expansion (TCE) similar in magnitude to a TCE of the first stress-inducing layer.

15 18. The micro-structure relay of claim 17 wherein the intrinsic stress of the compensation layer lower than the intrinsic stress of the first stress layer to reduce the influence of the compensation layer on the support member.

20 19. The microstructure relay of claim 2 further comprises a second support member, the second support member having a first end fixed to the body and the second contact supported at a second end on an upper surface of the second support member.

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20. The micro-structure relay of claim 19 further comprises a stress-inducing layer on the upper surfaces of the first and second support members, the stress layer inducing a compressive stress on support member to cause it to bend away from the lower surface upper portion of the body.

21. The microstructure relay of claim 20 wherein the support member comprises silicon.

22. The microstructure relay of claim 21 wherein the stress-inducing layer comprises silicon oxide.

23. The microstructure relay of claim 22 wherein the second support member is shorter than the first support member.

24. The microstructure relay of claim 23 wherein an over-travel is defined by the second support member.

25. The microstructure relay of claim 24 further comprises an over-travel region on the second support member to

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ensure the over-travel is not obstructed as the first support member is pivoted toward the lower surface.

26. A micro-relay comprising:

- 5 a body including upper and lower portions,  
a support member supported at a first end by the body to form a cantilever, wherein a major surface of the support member and a lower surface of the upper portion of the body forms a cavity; and
- 10 a first contact region located on the major surface at a second end of the support member, the first contact region comprising a first contact,  
the support member comprising an s-shape, wherein a body of the support member bends in a direction away from the surface of the upper portion of the body and the first contact region bends in a direction toward the surface of the upper portion of the body,
- 15 the s-shaped support member, when pivoted toward the lower surface, causes the first contact to be electrically coupled to a counter contact.
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27. The micro-structure relay of claim 26 wherein the support member is pivoted toward the lower surface by electrostatic force, the electrostatic force generated by

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applying a voltage potential to the first and second electrodes, the first electrode is located on the upper surface and the second electrode is located on the lower surface.

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28. The microstructure relay of claim 27 further comprises a second contact region on the lower surface, the second contact region comprising the second contact.

10 29. The micro-structure relay of claim 28 wherein the s-shape support member comprises first and second stress layers, the first stress layer inducing a compressive stress on the support member to cause it to bend away from the lower surface, and the second stress layer inducing a  
15 tensile stress on the first contact region to cause the first contact region to bend toward the lower surface.

30. The microstructure relay of claim 29 wherein the bend of the first contact region toward the lower surface  
20 defines an over-travel.

31. The microstructure relay of claim 30 further comprising an over-travel region in the lower surface, the over-travel region accommodating the bend of the first

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contact region to prevent the over-travel from being obstructed.

32. The microstructure relay of claim 31 wherein the  
5 support member comprises silicon.

33. The microstructure relay of claim 32 wherein the first stress layer comprises silicon oxide.

10 34. The microstructure relay of claim 33 wherein the second stress layer comprises silicon nitride.

35. The microstructure relay of claim 34 wherein the lower portion of the body comprises silicon.

15 36. The microstructure relay of claim 35 wherein the upper portion comprises nickel.

37. The micro-structure relay of claim 36 further  
20 comprising a dielectric layer insulating the upper portion of the body from the second contact and second electrode.

38. The microstructure relay of claim 31 wherein the support member comprises nickel.

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39. The microstructure relay of claim 38 wherein the first stress-inducing layer comprises silicon oxide and the second stress-inducing layer comprises polysilicon.

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40. The microstructure relay of claim 39 wherein the polysilicon comprises doped polysilicon.

41. The micro-structure relay of claim 40 further comprises a compensation layer on a surface of the support member opposite the upper surface, the compensation layer having a thermal coefficient of expansion (TCE) similar in magnitude to a TCE of the first stress-inducing layer.

42. The micro-structure relay of claim 41 wherein the intrinsic stress of the compensation layer lower than the intrinsic stress of the first stress layer to reduce the influence of the compensation layer on the support member.

43. The micro-structure relay of claim 27 further comprises a second support member, the second support member having a first end fixed to the body and the second contact supported at a second end on an upper surface of the second support member, wherein the support member is

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pivoted toward the lower surface by electrostatic force,  
the electrostatic force generated by applying a voltage  
potential to the first and second electrodes, the first  
electrode is located on the upper surface and the second  
5 electrode is located on the lower surface.

44. The micro-structure relay of claim 43 further  
comprises a stress-inducing layer on the upper surfaces of  
the first and second support members, the stress layer  
10 inducing a compressive stress on support member to cause it  
to bend away from the lower surface upper portion of the  
body.

45. The microstructure relay of claim 44 wherein the  
15 support member comprises silicon.

46. The microstructure relay of claim 45 wherein the  
stress-inducing layer comprises silicon oxide.

20 47. The microstructure relay of claim 46 wherein the  
second support member is shorter than the first support  
member.

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48. The microstructure relay of claim 47 wherein an over-travel is defined by the second support member.

49 The microstructure relay of claim 48 further comprises  
5 an over-travel region on the second support member to  
ensure the over-travel is not obstructed as the first  
support member is pivoted toward the lower surface.

50. A process for fabricating microstructures comprising:  
10 providing a substrate with a first doped region  
comprising a dopants of a first type;

providing a second doped region comprising dopants of  
a second type, wherein the first and second doped regions  
form a pattern on a surface of the substrate corresponding  
15 to a feature;

etching process to remove the first or the second  
doped region from the surface of the substrate to form the  
feature, wherein the doped region that is removed comprises  
a high dopant concentration to enable the etchant to form  
20 the openings with lateral dimenions of less than 250  $\mu\text{m}$ .

51. The process as recited in claim 50 wherein the high  
dopant concentration in the doped region that is removed

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comprises a dopant concentration that results in a resistivity of less than 6 ohm - cm.

52. The process as recited in claim 50 wherein the high  
5 dopant concentration in the doped region that is removed  
comprises a dopant concentration that results in a  
resistivity of about 50 mohm - cm.

53. The process as recited in claim 52 wherein the opening  
10 is less than 60  $\mu$ m.

54. The process as recited in claim 50 wherein the first  
region comprises p-type dopants to form a p-type dopant  
region and the second doped region comprises n-type dopants  
15 to form an n-doped region.

55. The process as recited in claim 54 wherein the p-typed  
doped region is provided by a p-type substrate and the n-  
typed doped region is provided by selectively doping the  
20 substrate by ion implantation to form the pattern.

56. The process as recited in claim 54 wherein the p-typed  
doped region is provided by implanting p-type dopants into

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the substrate and the n-typed doped region is provided by selectively implanting n-type dopants into the substrate to form the pattern.

5 57. The process as recited in claims 55 or 56 wherein the p-type region is removed by electrochemical etching.

58. The process as recited in claim 57 wherein the dopant concentration of the p-type doped region results in the p-typed region having a resistivity less than 6 ohms - cm.

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59. The process as recited in claim 57 wherein the dopant concentration of the p-type doped region results in the p-typed region having a resistivity of about 50 mohm - cm.

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60. The process as recited in claim 59 wherein the opening is less than 60  $\mu\text{m}$ .

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